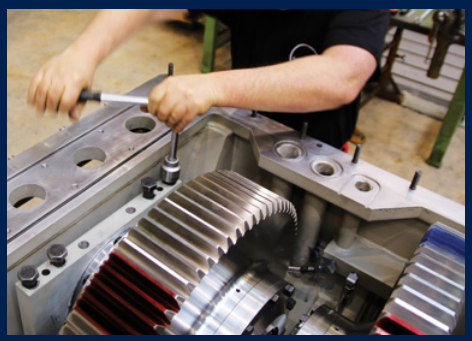
RENK MAAG

Innovative Power Transmission



# RENK-MAAG Drop Box K-112/2

Specially designed for use in heavy duty locomotives!

# The Swiss drop in solution – with full steam and full power on the way

The RENK-MAAG GmbH Drop Box K-112/2 is specially designed for the use in direct drive locomotives. It is driven by a diesel engine through a 6 speed transmission and transmits the required power within the defined speed range from standstill to maximum speed. The nearly equal ratio forward and reverse gears are selected by a set of hydraulic multidisc clutches.

The Drop Box has an integrated oil reservoir therefore it is not necessary to have a separate oil tank.
To avoid power loss due to gears dragging through oil, the sump is almost dry and the output wheel is partly covered.
Furthermore a hydraulic block is mounted on top of the Drop Box which allows shifting the hydraulic multidisc clutches. The hydraulic system is powered by shaft driven pumps that scavenge the sump, feed the oil to the Drop Box oil inlet and also raise the oil pressure to shift the hydraulic multidisc clutches.

All in all the RENK-MAAG GmbH Drop Box provides high performance and is designed against our top notch quality and technical standards.

## Efficiency improvements

The RENK-MAAG Drop Box improved the efficiency at full load from around 70% to more than 96% in forward and reverse.
- Partly covered output gear to reduce losses of oil dragging.
- Engaged clutch discs transmit torque without slippage.
- No cooling oil in the clutch to reduce the drag torque of the disengaged clutch.

## Design characteristics

**Casing**
The casing is manufactured from welded steel plates. It is of a particularly rigid and stiff design comprising two main sections (upper and lower part).

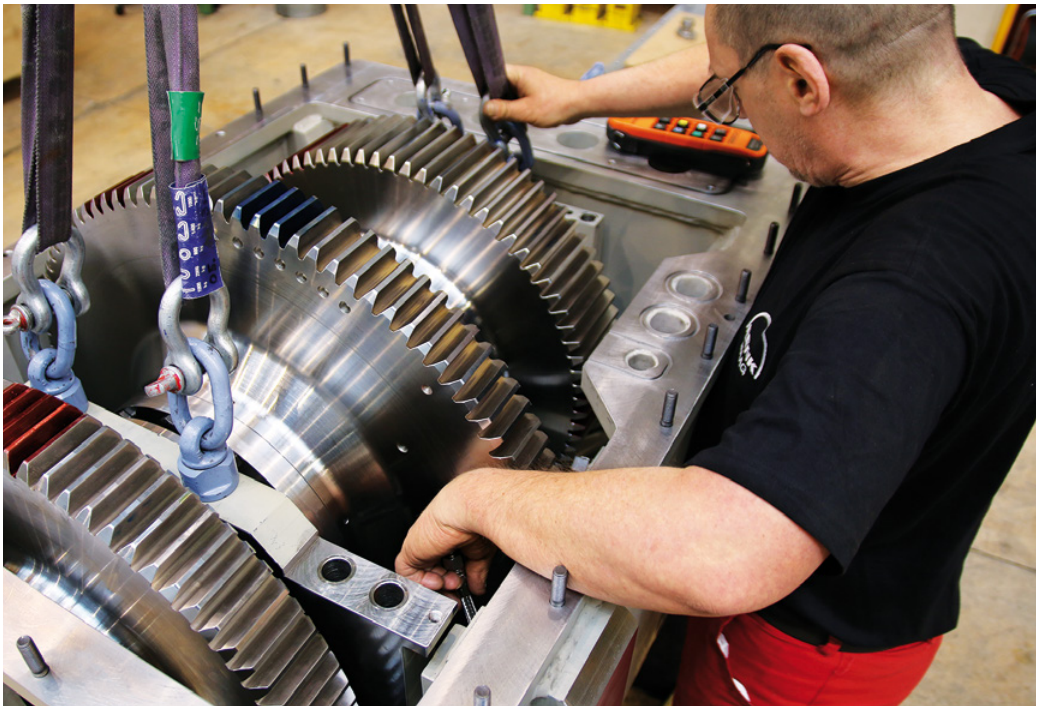
**Shafts and gears**
All shafts and gears are produced from high quality through hardened steel.
The teeth are precision-ground. The tooth flanks are provided with the necessary profile and lead modifications to ensure smooth tooth meshing and a correct tooth contact pattern.

**Bearings**
All rotors are supported with pressure lubricated roller bearings.

**Gear shift**
The Drop Box has the opportunity either to drive in forward or reverse direction with a nearly equal ratio.

**Clutches**
Two special designed hydraulic multidisc friction clutches are used to transmit the

**Features of Drop Box K-112/2**
- Specially designed for use in heavy duty locomotives
- Driving direction is either forward, reverse or neutral
- No slippage hydraulic multidisc friction clutch for each drive direction
- Spur gear with special modifications and precision ground toothing
- Special rigid construction of main casing
- Casing internal oil reservoir
- Roller bearings for all rotors
- Interface for quick oil drain and refill
- Easy accessibility for maintenance
- Very long service intervals
- Excellent payback time



torque without slippage. For each drive direction one clutch is in use (forward and reverse).
The clutches allow a quick shift process with no synchronisation issue. Shifting is conducted at standstill of the locomotive.

**Hydraulic system**
The hydraulic system of the Drop Box is divided into three parts:
- Drainage of the Drop Box sump
- Low pressure to lubricate the gearbox
- High pressure to shift the clutches

The Drop Box features a dry sump which is emptied by the scavenge pump and the oil is fed into the casing internal oil reservoir. A second pump feeds the oil through an external system (filter, cooler, etc.) to the Drop Box inlet to lubricate all roller bearings and gear meshing. A third pump is used to provide high pressure which is required by the clutches to transmit torque.

The pumps are combined into one so called shaft through triple pump and can be driven by one PTO (power take off) at the diesel engine.

A hydraulic block allows shifting to either forward, reverse or neutral. It also limits the maximum pressure provided by the third pump.

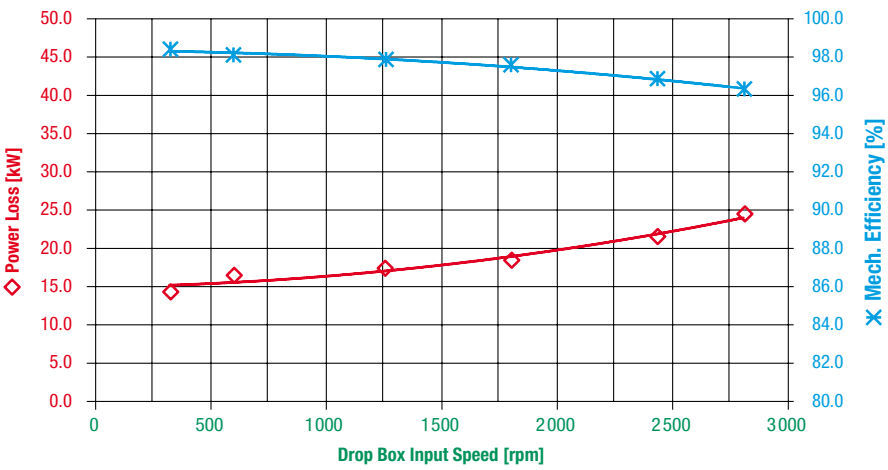
**Seals**
Radial shaft seals are used at input and output shafts for maximum tightness.

**Accessibility for Maintenance**
Drop Box K-112/2 is designed for optimum accessibility to all internal parts.

## Gearbox monitoring system

- **Oil temperatures**
  – Sump
  – Lubrication system inlet (bearing and tooth mesh)
- **Oil pressure**
  – Inlet (LP)
  – Forward clutch (HP)
  – Reverse clutch (HP)
- **Oil level sensor**
  – Sump
  – Reservoir
- **Pressure gauge connection provided**
  – Hydraulic block inlet
  – Forward clutch
  – Reverse clutch
  – Lubrication system inlet (bearing and tooth mesh)
- **Interface for speed sensors provided**
  – Input shaft
  – Clutch shaft
- **Interfaces for vibration sensors provided**
  – Upper casing two milled surfaces
  – Lower casing one milled surface

## Power Loss and Efficiency of Drop Box K-112/2



# Product portfolio

## RENK-MAAG provides new products, services, inspections, repairs and spare parts (incl. complete gearboxes) for all types of MAAG/RENK-MAAG gearboxes.

## Turbo Gearboxes

### Parallel Shaft Gearbox

**Developed for applications in generator, compressor, fan and pump drive markets.**

- Since 1915 over 11 000 gearboxes installed

**Applications / Industries**

- Oil and gas
- Power generation
- Petrochemical industry
- Steel production
- Paper industry
- Energy recovery systems
- Testbeds

**Features**

- Partnership with various companies for tailor made gearbox designs
- Power range up to 180 000 kW
- Gear ratio
  single stage: $i \leq 10$
  double stage: $i \leq 80$
- Speeds up to 63 000 rpm

### HET Gear® (Vacuum Gearbox)

**For highest efficiency where it is needed – world's most efficient turbo gear.**

- 1996 pioneering with first built vacuum gearbox

**Applications / Industries**

- Power generation
- Compressor drives
- Energy recovery
- Combined Cycle Power Plant (CCPP)
- Combined Heat and Power (CHP) plant

**Features**

- Highest efficiency
- Proven 99.3 % at 90 000 kW
- Power range 15 000 to 180 000 kW
- Viable at pitchline velocity > 120 m/s
- Gear ratio
  single stage: $i \leq 10$
- Speeds up to 36 000 rpm

### Integral Gearbox MULTICOM®

**The heart of a multi-tiered gearbox compressor and / or expander.**

- First 10 stage integrally geared compressor gearbox ever built

**Applications / Industries**

- Gas compression trains used in petroleum, chemical and gas industry
- Air separation
- Oil and gas
- Power recovery (in combination with RENK-MAAG Synchronous Clutch Coupling)

**Features**

- 1 to 10 stages
- Efficiency booster available to reduce losses
- Radial Compressors
- Up to 63 000 rpm
- Compressor mounting Hirth toothing or polygon
- Power range up to 50 000 kW
- Gear ratio
  single stage: $i \leq 20$
  double stage: $i \leq 80$

### High-Speed Epicyclic Gear

**A simple, efficient principle when space is at a premium – plant cost (CAPEX) can be reduced.**

- Over 1000 gearboxes installed in more than 55 years

**Applications / Industries**

- Power generation
- Compressor drives
- Pump drives
- Marine applications
- Paper industry
- Hydroelectric generation

**Features**

- Ongoing GT-Generator drive program with more than 70 units running
- Partnership with various companies for tailor made gearbox designs
- Power range up to 45 000 kW
- Gear ratio
  single stage: $1.6 \leq i \leq 13$
  double stage: $8 \leq i \leq 80$
- Speeds up to 36 000 rpm

### Special Gears [1] e.g. clutch gearboxes

**Recovered energy in modern plant processes is automatically and directly fed back to the train.**

- Over 185 clutch gearboxes installed

**Applications / Industries**

- Energy recovery increaser gear between expander and blower in steel works (BPRT [2])
- Energy recovery reducer gear between steam turbine and fan in steel works (SHRT [3])

**Features**

- Integrated RENK-MAAG Synchronous Clutch Coupling possible
- Power range 1000 to 100 000 kW
- Gear ratio
  single stage: $i \leq 8$
- Speeds up to 10 000 rpm

**All RENK-MAAG gearboxes are according to DIN / ISO, AGMA or API (other norms or special design upon request).**
**Ask also for RENK-MAAG gear couplings (such as automatically synchronizing, engaging on demand or completely disengageable).**

[1] RENK-MAAG develops and manufactures special gears for an enormously wide range of applications as for small GT / ST power generation plants with synchronous condenser or peaking power in combined cycle arrangement and others e. g. for marine propulsion trains with Power Take In (PTI). The clear strength lies in the close technical cooperation with customers. A detailed specification and required gearbox design for optimum solutions are discussed and developed in person with the customer.

[2] BPRT = Blast Furnace Power Recovery Turbine

[3] SHRT = Sintering Heat Recovery Turbine

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**Our manufacturing and other operational activities are implemented in accordance with our internal quality assurance system and in strict compliance with ISO 9001:2015, ISO 14001:2015 and OHSAS 18001:2007.**

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